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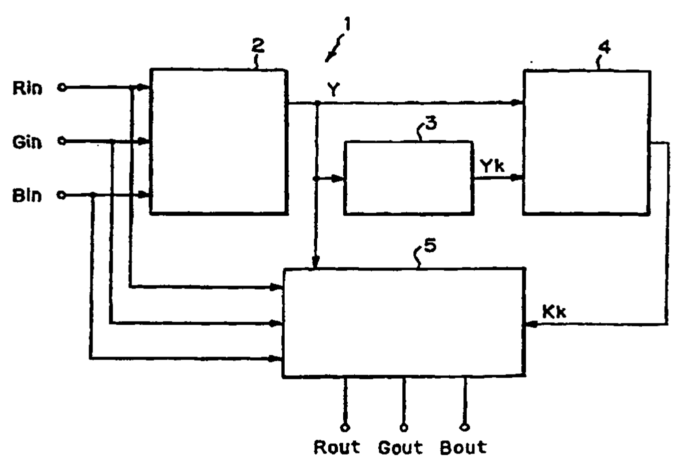

(57) Abstract

It is an object to provide a knee circuit in which a hue on the output side does not differ from a hue on the input side. To this end, the knee circuit includes a virtual luminance signal generator for generating a virtual luminance signal (Y) based on at least one input color signal (Rin, Gin and Bin), a virtual correction value generator for monitoring whether the virtual luminance signal (Y) is equal to or more than a knee point (NP) and for generating a virtual correction value (Yk) by performing a knee correction with respect to the virtual luminance signal (Y) when it is equal to or more than the knee point (NP), a proportional value generator for generating a proportional value (Kk) showing a ratio of the virtual correction value (Yk) to the virtual luminance signal (Y) by dividing the virtual correction value (Yk) by the virtual luminance signal (Y), and a correction color signal generator for multiplying of each of the input color signals (Rin, Gin and Bin) by the proportional value and for outputting a multiplication result as corrected color signals (Rout, Gout and Bout), that is, color signals on which knee correction has been performed.

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Knee correction.

This invention relates to a method of and circuit for performing knee correction of color signals.

Prior Art

A video camera is required to have a function of vividly and simultaneously photographing bright objects such as a light source and dark objects such as shadows. To satisfy this requirement, a knee circuit is mounted in a video camera for performing correction (knee correction) for lowering the level of an output signal of a CCD (charge-coupled device) when it exceeds a predetermined threshold (knee point). Three knee circuits are mounted in a triple-plate type video camera in which three CCDs are mounted. As a result, knee correction is performed on a red color signal R, a green color signal G and a blue color signal B. Here, an explanation will be given with the assumption that knee correction is independently performed on each of the color signals.

The same threshold is set for each knee circuit to specify a level (knee point NP) of an input signal for starting the knee correction. Each knee circuit starts knee correction when the level of an input signal reaches the knee point NP.

An explanation will be given of the operation of a conventional knee circuit in reference to Fig. 8.

Fig. 8 illustrates waveform diagrams showing color signals that are outputted from the conventional knee circuit. In Fig. 8, the axis of ordinates (vertical axis) shows a level of a color signal that is outputted from the knee circuit, and the axis of abscissa (horizontal axis) shows a level of exposure (luminance) of an object. The levels of the red corrected color signal Rout, the green corrected color signal Gout and the blue corrected color signal Bout as illustrated in the drawing designate a case where an image of a reddish object, for example an object having "skin color", is photographed, in which the red color signal Rin having a level higher than those of the green color signal Gin and the blue color signal Bin, is inputted.

When the luminance of the object is enhanced, firstly, only the color signal Rin (Rout) reaches the knee point NP. As a result, only knee correction with respect

to the color signal Rin is started (luminance I_1). Thereafter, the color signals Gin and Bin successively reach the knee point NP and the correction color signals Gout and Bout on which knee correction has been performed are outputted (luminance I_2, I_3).

When the luminance is from I_1 through I_2, knee correction is performed only on the color signal Rin and when the luminance is from I_2 to I_3, knee correction is performed on each of the color signals Rin and Gin. Further, when the luminance is equal to or more than I_3, knee correction is performed on all of the color signals Rin, Gin and Bin. That is, the corrected color signals Rout, Gout and Bout on which knee correction is performed are outputted.

As explained above, in the conventional knee circuit, there is a situation in which knee correction is performed on only one or two color signals. When knee correction is performed on only one or two color signals, a correlation of (R-G):(B-G) among the corrected color signals that are outputted from the knee circuit differs from that of the color signals input to the knee circuit. The change of correlation signifies that hues differ between the input side and the output side of the knee circuit. Accordingly, there is a problem in the conventional knee circuit in which the hue on the input side differs from the hue on the output side after knee correction is performed.

This invention has been arrived at in view of the above problem and it is an object thereof to provide a knee correction in which the hue on the input side does not differ from that on the output side.

According to a first aspect of the present invention, there is provided a knee circuit comprising a virtual luminance signal generating means for generating a virtual luminance signal Y on the basis of one or at least two selected from a group of input signals including of a red color signal Rin, a green color signal Gin and a blue color signal Bin, a virtual correction value generating means for generating a virtual correction value Yk by performing knee correction with respect to the virtual luminance signal Y when a level of the virtual luminance signal Y is equal to or more than a knee point NP at which the knee correction is to be started, a proportional value generating means for generating a proportional value Kk indicating a ratio of the virtual luminance signal Y to the virtual

correction value Yk, and a corrected color signal generating means for generating corrected color signals Rout, Gout and Bout by multiplying of each of the color signals Rin, Gin and Bin by the proportional value Kk when the level of the virtual luminance signal Y is equal to or more than the knee point NP.

According to a second aspect of the present invention, there is provided the knee circuit according to the first aspect further comprising a high luminance color suppressing circuit, said high luminance suppressing circuit having a coefficient generating means for generating a first coefficient K_1 defined as

(Gdet - Gin)/(Gdet - Gth),

a second coefficient K_2 defined as

(Rmax - Yk)/(Rout - Yk),

and a third coefficient K_3 defined as

(Bmax - Yk)/(Bout - Yk),

on the basis of a saturation detection level Gdet specifying a level of the corrected color signal Gout at which color cannot be reproduced, a virtual detection level Gth which is set to a level that is less than the saturation detection level Gdet and more than the knee point NP, a red color maximum output level Rmax specifying a maximum level of red color at which output of the red color is allowable, and a blue color maximum output level Bmax specifying a maximum level of blue color at which output of the blue color is allowable, and

a correction color signal forming means for generating an output red color signal (Rend) defined as

$Yk + (Rout - Yk) \bullet K_0$,

an output green color signal Gend defined as

$Yk + (Gout - Yk) \bullet K_0$,

and an output blue color signal Bend defined as

$Yk + (Bout - Yk) \bullet K_0$

where $K_0 \leq 1$ and where K_0 is a minimum coefficient selected from the group consisting of the respective coefficients of K_1, K_2 and K_3, when the level of the green color signal Gin is equal to or more than the virtual detection level Gth, or when the level of the corrected color signal Rout is equal to or more than the red color maximum output level Rmax, or when the level of the corrected color signal Bout is equal to or more than the blue color maximum output level Bmax.

According to a third aspect of the present invention, there is provided the

knee circuit according to the first or the second aspect, wherein the virtual luminance signal generating means generates a virtual luminance signal Y defined as

$$0.6 \bullet Gin + 0.3 \bullet Rin + 0.1 \bullet Bin.$$

According to a fourth aspect of the present invention, there is provided the knee circuit according to the first or the second aspect, wherein the virtual luminance signal generating means generates a virtual luminance signal Y defined as

$$0.625 \bullet Gin + 0.25 \bullet Rin + 0.125 \bullet Bin.$$

According to a fifth aspect of the present invention, there is provided the knee circuit according to the first or the second aspect, wherein the virtual luminance signal generating means generates a virtual luminance signal Y defined as

$$0.5 \bullet Gin + 0.5 \bullet Rin.$$

According to a sixth aspect of the present invention, there is provided the knee circuit according to the first or the second aspect, wherein the virtual luminance signal generating means outputs a color signal having a maximum level selected from a group consisting of the respective color signals Rin, Gin and Bin as the virtual luminance signal Y. A further aspect of the invention provides a method as defined in claim 7.

The knee circuit of the present invention generates the virtual luminance signal Y in the virtual luminance signal generating means, based on one or at least two selected from the group consisting of the red color signal Rin, the green color signal Gin and the blue color signal Bin which are inputted to the knee circuit. The virtual correction value generating means monitors whether the virtual luminance signal Y is equal to or more than the knee point NP, and generates the virtual correction value Yk by performing knee correction on the virtual luminance signal Y when it is equal to or more than the knee point NP. The proportional value generating means divides the virtual correction value Yk by the virtual luminance signal Y and generates the proportional value Kk showing a ratio of the virtual correction value Yk to the virtual luminance signal Y. The corrected color signal generating means performs a multiplication of each of the input color signals by the proportional value Kk, and outputs the result as the corrected color signals Rout, Gout and Bout, or color signals on which knee correction has been performed.

The knee circuit of the present invention outputs any color signals equal to those on the input side, that is, color signals on which no knee correction has been performed, or color signals all of which have been subjected to knee correction.

Accordingly, there is no situation in which knee correction is performed on only one or two color signals. Accordingly, hues on the output side of the knee circuit are substantially equal to those on the input side.

BRIEF EXPLANATION OF THE DRAWINGS

Fig. 1 is a block diagram of a knee circuit of the present invention.

Fig. 2 is a flowchart showing the operation of the knee circuit of the present invention.

Fig. 3 illustrates first waveform diagrams of color signals output from the knee circuit of the present invention.

Fig. 4 is a second block diagram relating to a knee circuit of the present invention.

Fig. 5 is a flowchart showing the operation of the knee circuit.

Fig. 6 illustrates second waveform diagram of color signals output from a knee circuit of the present invention.

Fig. 7 illustrates third waveform diagrams of color signals output from the knee circuit of the present invention.

Fig. 8 illustrates waveform diagrams of color signals output from a conventional knee circuit.

Explanation of the Reference Numerals

1	knee circuit
2	virtual luminance signal generating means
3	virtual correction value generating means
4	proportional value generating means
5	corrected color signal generating means
6	coefficient generating means
7	output color signal generating means

Fig. 1 is a block diagram of a knee circuit of the present invention.

The illustrated knee circuit 1 comprises a microprocessor and digital circuits such as logic elements. Three primary color signals which have been converted from analog to digital, that is, the red color signal Rin, the green color signal Gin and the blue color signal Bin, are inputted to a virtual correction value generating means 2. The virtual

luminance signal generating means 2 generates a virtual luminance signal Y defined as the following equation (1) based on the input Rin, Gin and Bin color signals.

$$Y = 0.6 \bullet Gin + 0.3 \bullet Rin + 0.1 \bullet Bin \qquad (1)$$

The virtual luminance signal Y generated by the virtual luminance signal generating means 2 is inputted to a virtual correction value generating means 3. The virtual correction value generating means 3 generates a virtual correction value Yk by performing knee correction with respect to the virtual luminance signal Y when the level of the virtual luminance signal Y is equal to or more than the knee point NP. Further, when the level of the virtual luminance signal Y is less than the knee point NP, a virtual correction value Yk that is equal to the virtual luminance signal Y is generated.

The virtual correction value Yk which has been generated by the virtual correction value generating means 3 is inputted to a proportional value generating means 4. The proportional value generating means 4 generates a proportional value Kk by dividing the virtual correction value Yk by the virtual luminance signal Y, separately input to the proportional value generating means 4.

The proportional value Kk which has been generated by the proportional value generating means 4 is inputted to a correction color signal generating means 5. The corrected color signal generating means 5 generates a red correction color signal Rout, a green corrected color signal Gout and a blue corrected color signal Bout defined as the following equations (2), (3) and (4), based on the proportional value Kk and the color signals Rin, Gin and Bin that are separately inputted to the correction signal generating means 5.

$$Rout = Rin \bullet Kk \qquad (2)$$

$$Gout = Gin \bullet Kk \qquad (3)$$

$$Bout = Bin \bullet Kk \qquad (4)$$

Accordingly, the knee circuit 1 of the present invention performs knee correction simultaneously on all of the color signals Rin, Gin and Bin and outputs the corrected color signals Rout, Gout and Bout.

An explanation will be given of the operation of the knee circuit 1 of the present invention with reference to Fig. 2 and Fig. 3.

Fig. 2 is a flowchart showing the operation of the knee circuit 1 of the present invention, S indicating the start an E indicating the end. Fig. 3 illustrates waveform diagrams of color signals outputted from the knee circuit of the present invention. Fig. 3 illustrates waveform diagrams when signals the same as the three primary color signals shown in Fig. 8 are inputted to the knee circuit 1. The axis of ordinates (vertical axis)

designates the level of a color signal that is outputted from the knee circuit and the axis of abscissa (horizontal axis) designates exposure (luminance).

When the color signals Rin, Gin and Bin are inputted to the knee circuit 1, the virtual luminance signal generating means 2 generates the virtual luminance signal Y (Fig. 2: step S1). The generating of the virtual luminance signal Y is carried out successively or during a predetermined period.

The virtual correction value generating means 3 determines whether the level of the input virtual luminance signal Y is equal to or more than the predetermined knee point NP (step S2), and generates the virtual correction value Yk by performing knee correction on the virtual luminance signal Y (step S3), when the level is equal to or more than the knee point NP (Yes).

The proportional value generating means 4 generates the proportional value Kk by dividing the input virtual correction value Yk by the virtual luminance signal Y (step S4).

The corrected color signal generating means 5 performs multiplies of each of the input color signals Rin, Gin and Bin by the proportional value Kk, thereby generating corrected color signals Rout, Gout and Bout (step S5). When step S5 is performed (when the luminance is equal to or more than a luminance I0: Fig. 3), the color signals on which knee correction has been performed, that is, the corrected color signals Rout, Gout and Bout, are outputted from the knee circuit.

As explained above, knee correction of the color signals Rin, Gin and Bin is achieved by performing the processings of steps S1 through S5 in the knee circuit 1.

Further, when the level of the virtual luminance signal Y is less than the knee point NP in step S2 (No), the virtual correction value generating means 3 outputs, for example, the virtual correction value Yk, equal to the virtual luminance signal Y. As a result, the proportional value generating means 4 outputs the proportional value Kk, the value of which is "1". In this case, the corrected color signal generating means 5 outputs the corrected color signals Rout, Gout and Bout, each of which is equal to each of the color signals Rin, Gin and Bin (step S6). Accordingly, when step S6 is performed (when the luminance is less than I_0: Fig. 3), the corrected color signals Rout, Gout and Bout, each of which is equal to each of the color signals Rin, Gin and Bin, are outputted from the knee circuit.

Next, an explanation will be given of a knee circuit of the present invention having a high luminance color suppressing circuit in reference to Fig. 4 through

Fig. 7. When an image of an object having high luminance is taken, the level (luminance) of the color signal is excessively high. When the level of the color signal is excessively high, so-called color signal saturation occurs. Color signal saturation means a state in which the color of an object cannot be reproduced. Generally, a video camera is mounted with a high luminance color suppressing circuit. When a color signal is generated that corresponds to an object having high luminance the color of which cannot be reproduced, the high luminance color suppressing circuit forcibly sets the color signal to, for example, white color.

The level of a color saturation signal depends on each color signal, with the saturation level of the green color signal G generally being the lowest. Further, saturation levels increase from the red color signal R to the blue color signal B. The high luminance color suppressing circuit starts suppressing color signals when the green color signal Gin reaches it saturation level (saturation detection level Gdet), or when each of the corrected color signals Rout and Bout reaches each of maximum output levels Rmax and Bmax (for example, a maximum level (100%) of a video signal) at which output is allowable. Specifically, the high luminance color suppressing circuit performs setting (suppressing) which makes these signals approach values indicating white with increases in the input level.

Fig. 4 is a second block diagram relating to a knee circuit of the present invention.

In Fig. 4, portions which are the same as those in Fig. 1 have the same reference numerals allocating thereto, and explanation thereof will be omitted.

A knee circuit 1a shown in Fig. 4 is provided with a high luminance color suppressing circuit 8 comprising a coefficient generating means 6 and an output color signal generating means 7. The high luminance color suppressing circuit 8 is constituted by a part of a digital circuit of a microprocessor or such as a gate circuit which constitutes the knee circuit 1a.

The coefficient generating means 6 generates a first coefficient K_1 established by, for example, the following equation (5) based on the saturation detection level Gdet, a virtual detection level Gth and the green color signal Gin, and a second coefficient K_2 established by, for example, the following equation (6) and a third coefficient K_3 established by, for example, the following equation (7), based on the virtual correction value Yk, the corrected color signal Rout, the red color maximum output level Rmax, the corrected color signal Bout, and the blue color maximum output level Bmax.

$$K_1 = (\mathrm{Gdet} - \mathrm{Gin})/(\mathrm{Gdet} - \mathrm{Gth}) \qquad (5)$$

$$K_2 = (\mathrm{Rmax} - \mathrm{Yk})/(\mathrm{Rout} - \mathrm{Yk}) \qquad (6)$$

$$K_3 = (Bmax - Yk)/(Bout - Yk) \quad (7)$$

Further, the saturation detection level Gdet is a threshold specifying a level at which the green color signal Gin is saturated. The virtual saturation level Gth is set to a desired value which is less than the saturation detection level Gdet and more than the knee point NP. Each of the maximum output levels Rmax and Bmax is a value specifying each of the corrected color signals Rout and Bout which are at maximum among the color signals outputted from the knee circuit 1.

The virtual correction value Yk which has been generated by the virtual correction value generating means 3, the first coefficient K_1, the second coefficient K_2 and the third coefficient K_3 which have been generated by the coefficient generating means 6, and the corrected color signals Rout, Gout and Bout which have been generated by the corrected color signal generating means 5 are inputted to the output color signal generating means 7. The output color signal generating means 7 selects a minimum coefficient K_0 from the input first through third coefficients K_1 through K_3. Thereafter, the output color signal generating means 7 generates output color signals, that is, a red output color signal Rend established by the following equation (8), a green output color signal Gend established by the following equation (9) and a green output color signal Bend established by the following equation (10) based on the virtual luminance signal Y and the coefficient K_0.

$$Rend = Yk + (Rout - Yk) \bullet K0 \quad (8)$$

$$Gend = Yk + (Gout - Yk) \bullet K0 \quad (9)$$

$$Bend = Yk + (Bout - Yk) \bullet K0 \quad (10)$$

An explanation will be given of the operation of the high luminance color suppressing circuit 1 of the present invention with reference to Fig. 5 through Fig. 7. Fig. 5 is a second flowchart showing the operation of the knee circuit of the present invention (S is start, and E is end). Fig. 6 illustrates second waveform diagrams showing the operation of the knee circuit of the present invention, and Fig. 7 illustrates third waveform diagrams showing the operation of the knee circuit of the present invention. In Fig. 6 and Fig. 7, the axis of ordinates (vertical axis) designates the level of the output color signal which is outputted from the high luminance color suppressing circuit 1a, and the axis of abscissa (horizontal axis) designates the level of exposure (luminance).

Further, a structure other than the high luminance color suppressing circuit 8 performs the same operation as that in the case which has previously been explained with reference to Fig. 2 and Fig. 3, explanation of which will be given mainly with regard to the operation of the high luminance color suppressing circuit 8.

When the coefficient generating means 6 generates the first through third coefficients K_1, K_2 and K_3 (step S11), the output color signal generating means 7 determines whether the color signal Gin is equal to or more than the virtual detection level Gth (step S12). If the result of this determination is no, the output color signal generating means 7 determines whether the corrected signal Rout is equal to or more than the maximum output level Rmax (step S13). If the result of this determination is no, the output color signal generating means 7 further determines whether the corrected signal Bout is equal to or more than the maximum output level Bmax. (step S14).

When the color signal Gin has a value that is equal to or more than the virtual detection level Gth, the result of the determination in step S12 is yes as shown in Fig. 6. In receiving the result of the determination, the output color signal generating means 7 selects the minimum coefficient K_0 from the first through third coefficients K_1 through K_3 (step S15). Further, the output color signal generating means 7 generates the output color signals Rend, Gend and Bend based on the corrected color signals Rout, Gout and Bout, the virtual correction value Yk and the coefficient K_0 (step S16). When step S16 is performed (when the luminance is equal to or more than a luminance I_4 and less than a luminance I_5: Fig. 6), the output color signals Rend, Gend and Bend, in which the correlation among the color signals Rout, Gout and Bout is maintained, are outputted from the output color signal generating means 7 (high luminance color suppressing circuit 8).

When the color signal Rout is equal to or more than the maximum output level Rmax as shown in Fig. 7, the result of the determination in step S13 is yes. By receiving the result of the determination, the output color signal generating means 7 generates the output color signals Rend, Gend and Bend.

Similarly, when the result of the determination in step S14 is yes, steps S15 and S16 are performed, and the output color signals Rend, Gend and Bend are generated. Further, the output color signal generating 7 can forcibly set the value of the output color signal Rend to the maximum output level Rmax when the result of step S13 is yes and the value of the output color signal Bend to the maximum output level Bmax when the result of step S14 is yes.

When the result of step S14 is no, processing of the high luminance color suppression is not performed. That is, the output color signal generating means 7 outputs the corrected color signals Rout, Gout and Bout as the output color signals Rend, Gend and Bend.

As explained above, when steps S11 through S17 are performed in the

high luminance color suppressing circuit 8 (knee circuit 1a), the output red color signal Rend, the output green color signal Gend and the output blue color signal Bend, wherein high luminance color suppression processing has been performed, are provided while maintaining the correlation among the color signals Rin, Gin and Bin.

The present invention is not restricted to the above embodiments.

The virtual luminance signal generating means 7 may form a virtual luminance signal Y defined as the following equation (11) or (12) as well as the equation (1).

$$Y = 0.625 \bullet Gin + 0.25 \bullet Rin + 0.125 \bullet Bin \tag{11}$$

$$Y = 0.5 \bullet Gin + 0.5 \bullet Rin \tag{12}$$

The virtual luminance signal generating means 2 may compare the levels of the color signals Rin, Gin and Bin in generating the virtual luminance signal Y and use a color signal having a maximum level as the virtual luminance signal Y.

The corrected color signal generating means 5 may achieve the determination of outputting the color signals Rin, Gin and Bin as the corrected color signals Rout, Gout and Bout by monitoring the level of the virtual luminance signal Y similar to the virtual correction value generating means 3, or by separately receiving the information that the virtual luminance signal Y does not exceed the level of the knee point NP from the virtual correction value generating means 3.

With respect to the coefficient generating means 6, this may be removed from the high luminance color suppressing circuit 8 when the coefficient K_0 is set to "1", that is, when the correlation among the saturation detection level Gdet and the respective color signals need not be considered.

According to the knee circuit of the present invention, knee correction is performed simultaneously with respect to all of the color signals Rin, Gin and Bin, and therefore, provides color signals after knee correction by which the hue on the output side does not differ from the hue on the input side. Further, a state is avoided in which high luminance color suppression need be performed on a particular color signal or signals (one or two of the corrected color signals Rout, Gout and Bout), thereby providing color signals after suppression in which the hue on the output side does not differ from that on the input side.

Claims:

1. A knee circuit characterized by comprising:

a virtual luminance signal generating means for generating a virtual luminance signal Y on the basis of one or at least two selected from a group of input signals including of a red color signal Rin, a green color signal Gin and a blue color signal Bin;

a virtual correction value generating means for generating a virtual correction value Yk by performing knee correction with respect to the virtual luminance signal Y when a level of the virtual luminance signal Y is equal to or more than a knee point NP at which the knee correction is to be started;

a proportional value generating means for generating a proportional value Kk indicating a ratio of the virtual luminance signal Y to the virtual correction value Yk; and

a corrected color signal generating means for generating corrected color signals Rout, Gout and Bout by multiplying of each of the color signals Rin, Gin and Bin by the proportional value Kk when the level of the virtual luminance signal Y is equal to or more than the knee point NP.

2. The knee circuit as claimed in Claim 1 characterized by comprising a high luminance suppressing circuit, said high luminance suppressing circuit having:

a coefficient generating means for generating a first coefficient K_1 defined as

(Gdet - Gin)/(Gdet - Gth),

a second coefficient K_2 defined as

(Rmax - Yk)/(Rout - Yk),

and a third coefficient K_3 defined as

(Bmax - Yk)/(Bout - Yk),

on the basis of a saturation detection level Gdet specifying a level of the corrected color signal Gout at which color cannot be reproduced, a virtual detection level Gth which is set to a level that is less than the saturation detection level Gdet and more than the knee point NP, a red color maximum output level Rmax specifying a maximum level of red color at which output of the red color is allowable, and a blue color maximum output level Bmax specifying a maximum level of blue color at which output of the blue color is

allowable; and

a correction color signal generating means for generating an output red color signal Rend defined as

$Yk + (Rout - Yk) \bullet K_0$,

an output green color signal Gend defined as

$Yk + (Gout - Yk) \bullet K_0$,

and an output blue color signal Bend defined as

$Yk + (Bout - Yk) \bullet K_0$

where $K_0 \leq 1$ and K_0 is a minimum coefficient selected from a group consisting of respective coefficients of K_1, K_2 and K_3, when the level of the green color signal Gin is equal to or more than the virtual detection level Gth, when the level of the corrected color signal Rout is equal to or more than the red color maximum output level Rmax, or when the level of the corrected color signal Bout is equal to or more than the blue color maximum output level Bmax.

3. The knee circuit as claimed in Claim 1 or 2 characterized in that the virtual luminance signal generating means generates a virtual luminance signal Y defined as

$0.6 \bullet Gin + 0.3 \bullet Rin + 0.1 \bullet Bin$.

4. The knee circuit as claimed in Claim 1 or 2 characterized in that the virtual luminance signal generating means generates a virtual luminance signal Y defined as

$0.625 \bullet Gin + 0.25 \bullet Rin + 0.125 \bullet Bin$.

5. The knee circuit as claimed in Claim 1 or 2 characterized in that the virtual luminance signal generating means generates a virtual luminance signal Y defined as

$0.5 \bullet Gin + 0.5 \bullet Rin$.

6. The knee circuit as claimed in Claim 1 or 2 characterized in that the virtual luminance signal generating means outputs a color signal having a maximum level selected from a group consisting of the color signals Rin, Gin and Bin as the virtual luminance signal

7. A method of performing knee correction of color signals, characterized by comprising the steps of:

generating a virtual luminance signal Y on the basis of one or at least two selected from a group of input signals including a red color signal Rin, a green color signal Gin and a blue color signal Bin;

generating a virtual correction value Yk by performing knee correction with respect to the virtual luminance signal Y when a level of the virtual luminance signal Y

is equal to or more than a knee point NP at which the knee correction is to be started;

generating means for generating a proportional value Kk indicating a ratio of the virtual luminance signal Y to the virtual correction value Yk; and

generating means for generating corrected color signals Rout, Gout and Bout by multiplying of each of the color signals Rin, Gin and Bin by the proportional value Kk when the level of the virtual luminance signal Y is equal to or more than the knee point NP.

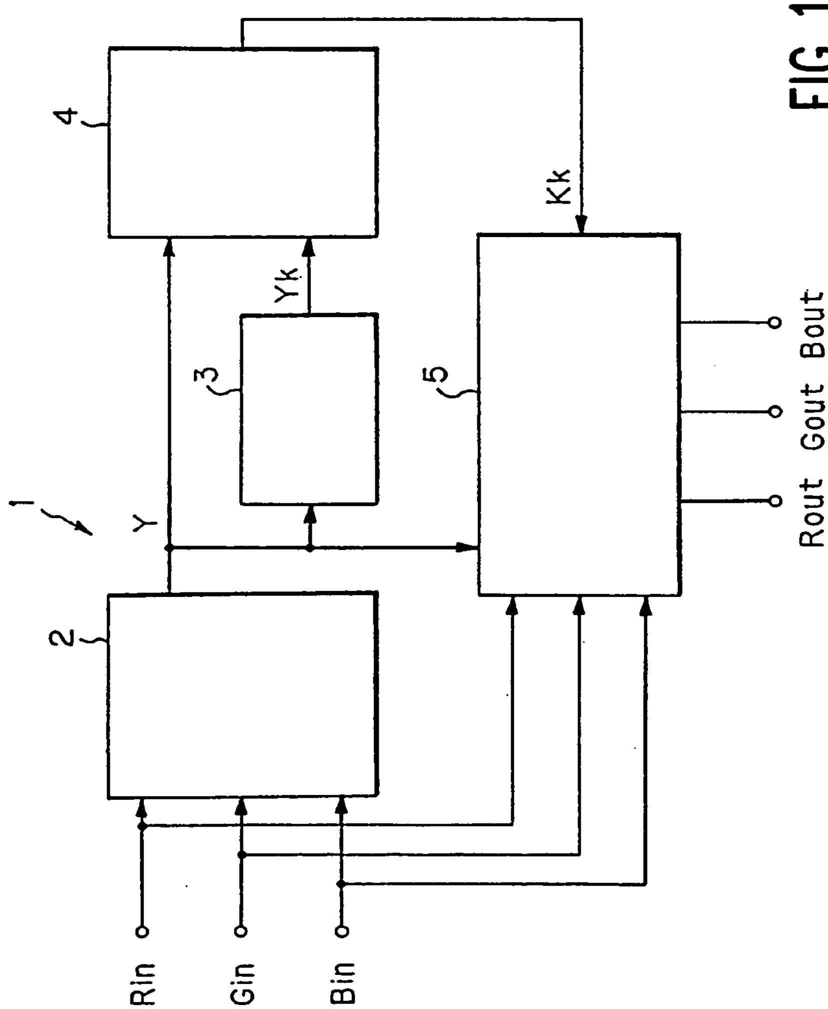

FIG. 1

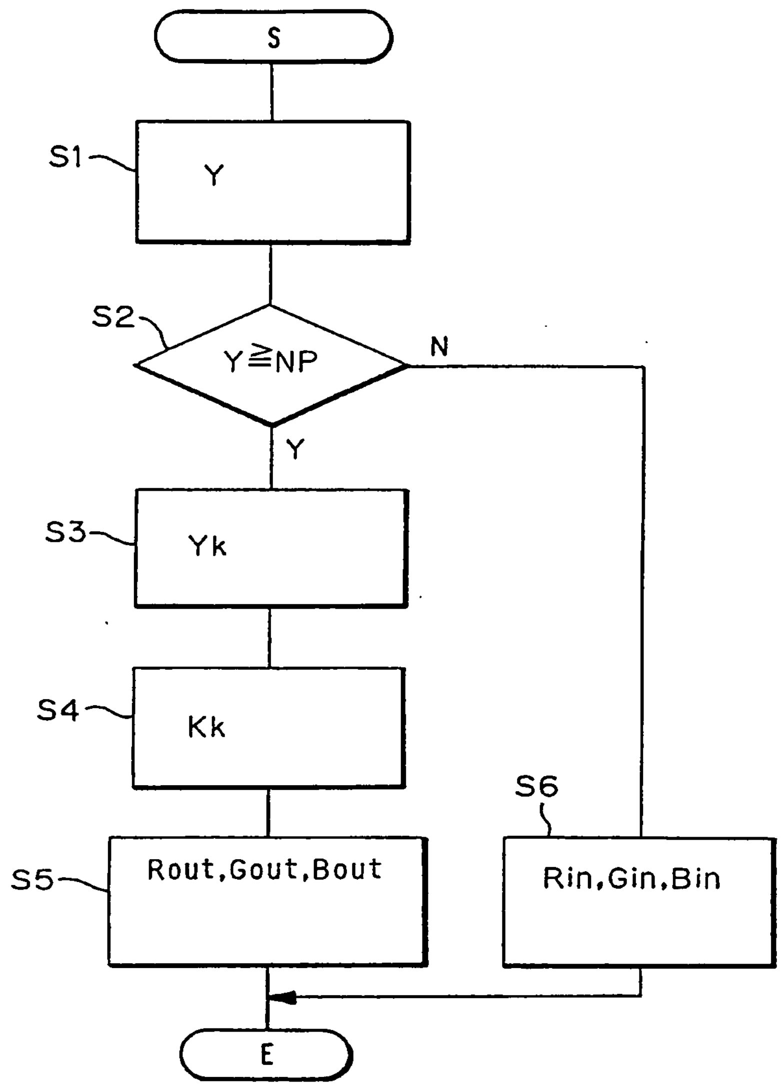

FIG. 2

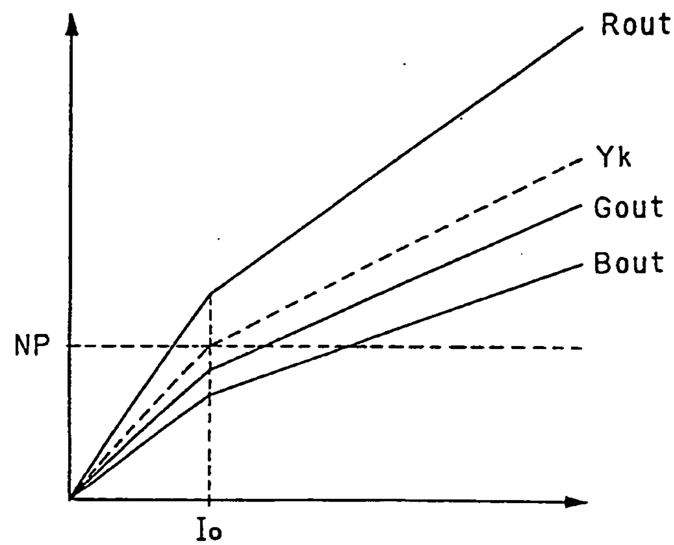

FIG. 3

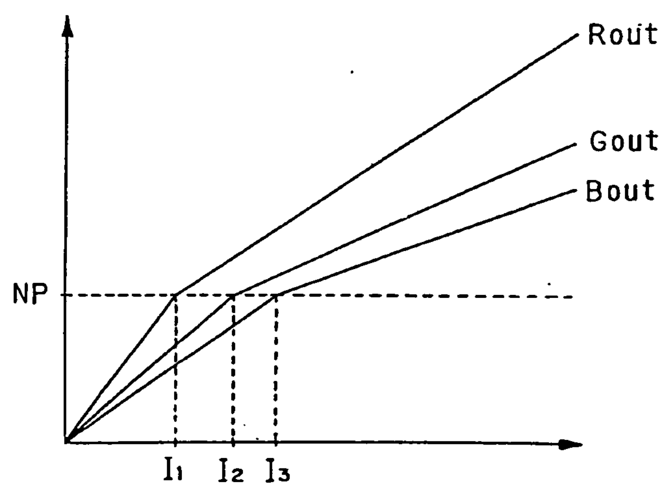

FIG. 8

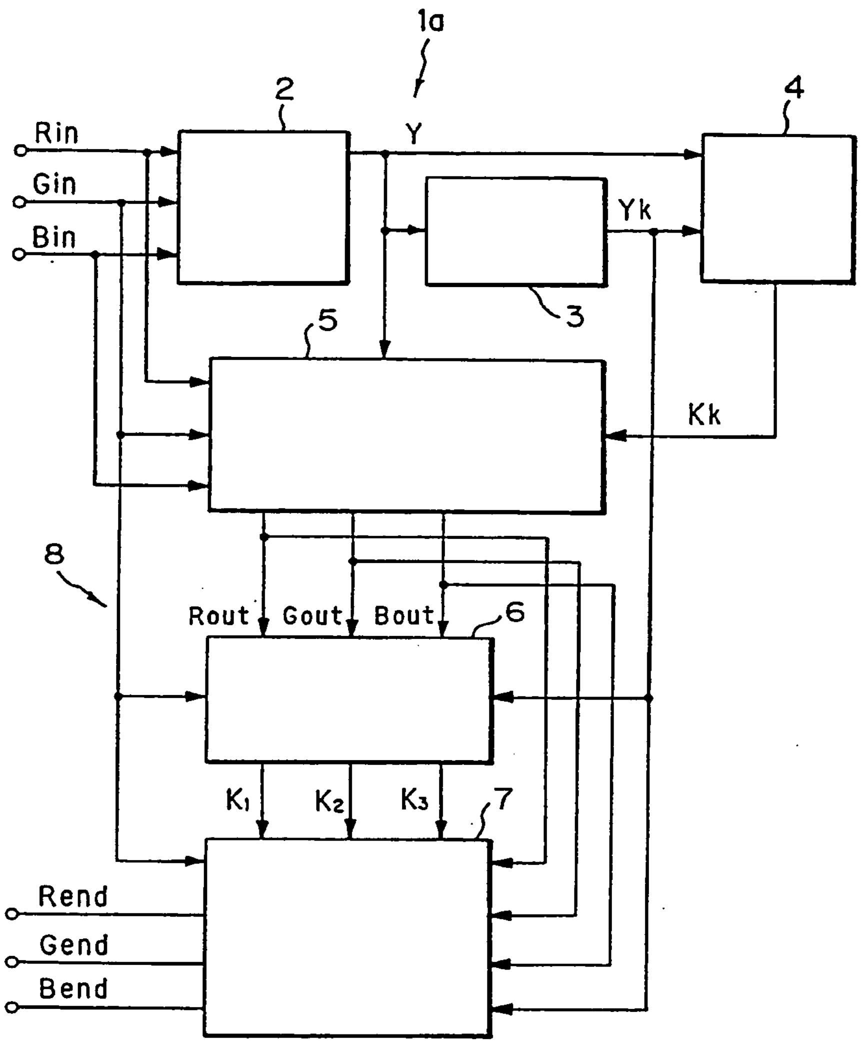
1a
2
4
Rin
Gin
Bin
Y
Yk
3
5
Kk
8
Rout
Gout
Bout
6
K1
K2
K3
7
Rend
Gend
Bend

FIG. 4

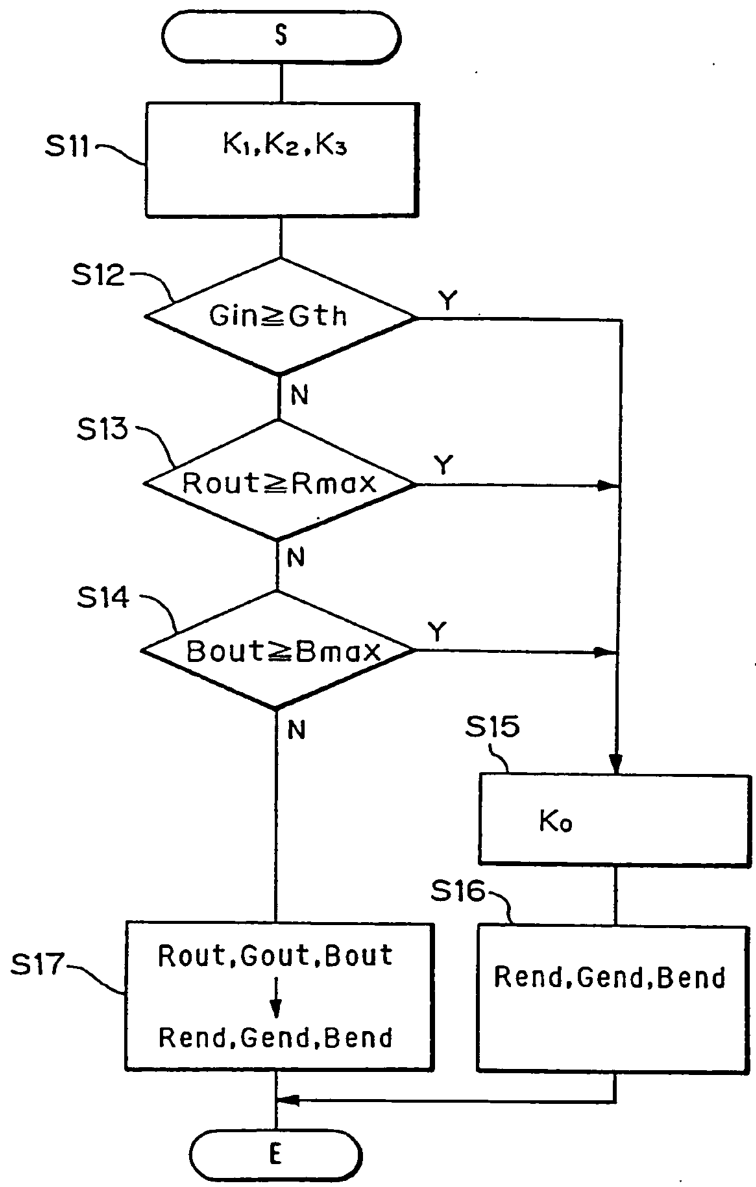
S
S11
K1,K2,K3
S12
Gin≧Gth
Y
N
S13
Rout≧Rmax
Y
N
S14
Bout≧Bmax
Y
N
S15
Ko
S16
Rend,Gend,Bend
S17
Rout,Gout,Bout
Rend,Gend,Bend
E

FIG. 5

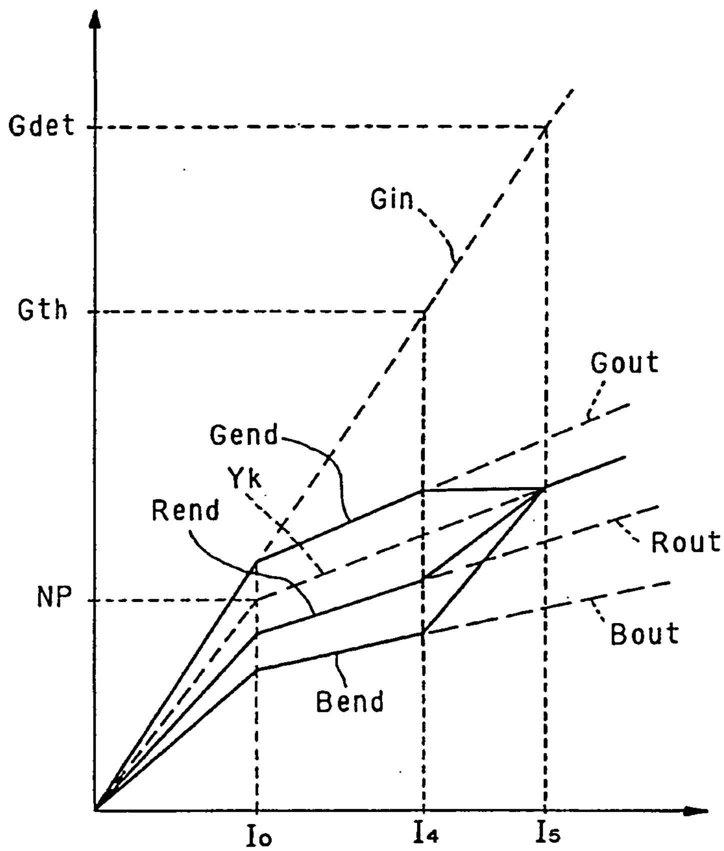

FIG. 6

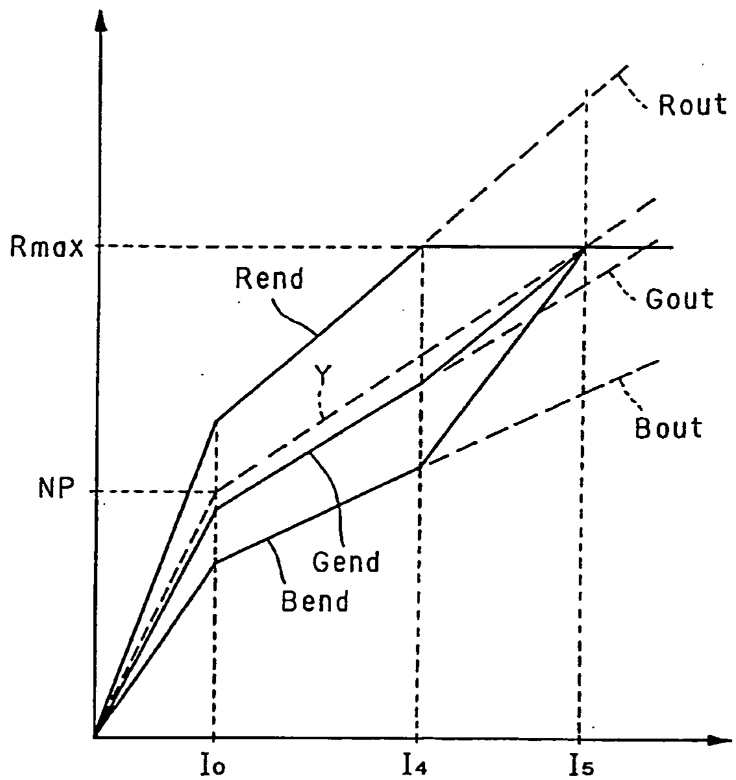

FIG. 7